

Amendments to the claims

Please amend Claims 26, 45 and 53 as follows.
Following entry of this Amendment, the pending claims
read as follows:

1 Claims 1-23 (cancelled).

1 24. (Original) A method of optimizing the performance
2 of a rod pump used for transferring fluid within a
3 fluid system, the rod pump including a rod string
4 carrying a downhole pump, and a variable drive coupled
5 to the rod string for reciprocating the rod string
6 within the fluid system, the method comprising the
7 steps of:

8 determining torque and velocity inputs to the rod
9 pump;

10 using the torque and velocity inputs to calculate
11 values for one or more operating parameters for the
12 rod pump;

13 using one or more of the operating parameter
14 values to produce command signals; and

15 using the command signals to vary the velocity of
16 the downhole pump to cause the downhole pump to
17 closely follow the polished rod position while
18 limiting tensile and compressive forces excursions in
19 rod load as the rod string is being reciprocated.

1 25. (Original) The method according to claim 24,
2 wherein determining torque and velocity inputs
3 includes the steps of:

4 measuring electrical voltage applied to a drive
5 motor of the variable drive and electrical current
6 drawn by the drive motor; and

7 using the measured values of electrical voltage
8 and current to calculate values of motor torque and
9 motor velocity for the drive motor.

1 26. (Currently Amended) A method of controlling the
2 performance of a rod pump used for transferring fluid
3 within a fluid system, the rod pump including a rod
4 string carrying a downhole pump, the rod string
5 including a polished rod, the method comprising the
6 steps of:
7 determining values of torque and velocity inputs
8 to the rod pump;
9 using the torque and velocity values to calculate
10 values for one or more operating parameters for the
11 rod pump;
12 using one or more of the operating parameter
13 values to produce command signals; and
14 using the command signals to vary the velocity of
15 the rod pump to at least limit excursions in rod load
16 to preset limits.

1 27. (Original) The method according to claim 26,
2 wherein the operating parameters include at least one
3 of rod load, rod position and rod velocity.

1 28. (Original) The method according to claim 26,
2 wherein using the operating parameter values to
3 produce command signals includes the steps of
4 obtaining a value representing rod load;
5 obtaining a value representing rod position;
6 using the values of rod load and rod position to
7 obtain an estimate of the velocity of the downhole
8 pump; and

9 using the difference between the rod velocity and
10 the downhole pump velocity in producing the command
11 signals.

1 29. (Original) The method according to claim 27,
2 wherein using the operating parameter values to
3 produce command signals includes the step of obtaining
4 an estimate of velocity of the downhole pump using at
5 least the value of rod load.

1 30. (Original) The method according to claim 29,
2 wherein obtaining an estimate of velocity of the
3 downhole pump includes using at least rod load along
4 with a simulation model to predict the velocity of the
5 downhole pump.

1 31. (Original) The method according to claim 30,
2 wherein the simulation model is based on a multi-
3 section model of the rod string.

1 32. (Original) The method according to claim 30,
2 wherein the simulation model is based on a wave
3 equation model of the rod string.

1 33. (Original) The method according to claim 30,
2 wherein the simulation model is based on a single
3 section model of the rod string.

1 34. (Original) The method according to claim 27,
2 wherein using the operating parameter values to
3 produce command signals includes the steps of using
4 one or more of the operating parameter values to
5 calculate a value representing rod load and comparing
6 the rod load value with preset upper and lower load
7 limit values.

1 35. (Original) The method according to claim 26,
2 wherein determining torque and velocity inputs
3 includes the steps of:
4 measuring electrical voltage applied to a drive
5 motor of the variable drive and electrical current
6 drawn by the drive motor; and
7 using the measured values of electrical voltage
8 and current to calculate values of motor torque and
9 motor velocity for the drive motor.

1 36. (Original) A method of controlling the performance
2 of a rod pump used for transferring fluid within a
3 fluid system, the rod pump including a rod string
4 carrying a downhole pump, and a variable drive
5 including an electrical drive motor coupled to the rod
6 string for reciprocating the rod string; the method
7 comprising the steps of:
8 measuring electrical voltage applied to the drive
9 motor and electrical current drawn by the drive motor;
10 using the measured values of electrical voltage
11 applied to the drive motor and current drawn by the
12 drive motor to calculate values of motor torque and
13 motor velocity for the drive motor;
14 using the values of motor torque and motor
15 velocity to calculate values representing operating
16 parameters for the rod pump;
17 using one or more of the operating parameter
18 values to produce command signals; and
19 using the command signals to vary the velocity of
20 the downhole pump to cause the downhole pump to
21 closely follow the polished rod position while
22 limiting tensile and compressive forces excursions in
23 rod load as the rod string is being reciprocated.

1 37. (Original) The method according to claim 36,
2 wherein the operating parameters include at least one
3 of rod load, rod position and rod velocity.

1 38. (Original) The method according to claim 36,
2 wherein using the operating parameter values to
3 produce command signals includes the steps of
4 obtaining a value representing rod load;
5 obtaining a value representing rod position;
6 using the values of rod load and rod position to
7 obtain an estimate of the velocity of the downhole
8 pump; and
9 using the difference between the rod velocity and
10 the downhole pump velocity in producing the command
11 signals.

1 39. (Original) The method according to claim 37,
2 wherein using the operating parameter values to
3 produce command signals includes the step of obtaining
4 an estimate of velocity of the downhole pump using at
5 least the value of rod load.

1 40. The method according to claim 39, wherein
2 obtaining an estimate of velocity of the downhole pump
3 includes using at least rod load along with a
4 simulation model to predict the velocity of the
5 downhole pump.

1 41. (Original) The method according to claim 40,
2 wherein the simulation model is based on a multi-
3 section model of the rod string.

1 42. (Original) The method according to claim 40,
2 wherein the simulation model is based on a wave
3 equation model of the rod string.

1 43. (Original) The method according to claim 40,
2 wherein the simulation model is based on a single
3 section model of the rod string.

1 44. (Original) The method according to claim 37,
2 wherein using the operating parameter values to
3 produce command signals includes the steps of using
4 one or more of the operating parameter values to
5 calculate a value representing rod load and comparing
6 the rod load value with preset upper and lower load
7 limit values.

1 45. (Currently Amended) A pump control system for
2 controlling the performance of a rod pump used for
3 transferring fluid within a fluid system, the rod pump
4 including a rod string carrying a downhole pump that
5 is reciprocated, the pump system comprising:
6 means for determining values of torque and
7 velocity inputs to the rod pump;
8 means for using the torque and velocity values to
9 calculate values for one or more operating parameters
10 for the rod pump;
11 means for using one or more of the operating
12 parameter values to produce command signals for
13 controlling the rod pump to vary the velocity of the
14 rod pump to limit excursions in rod load to preset
15 limits.

1 46. (Original) The pump control system according to
2 claim 45, wherein the means for using the operating

3 parameter values to produce command signals includes
4 means for obtaining a value representing rod load;
5 means for obtaining a value representing rod position;
6 means for using the values of rod load and rod
7 position to obtain an estimate of the velocity of the
8 downhole pump; and means for using the difference
9 between the rod velocity and the downhole pump
10 velocity in producing the command signals.

1 47. (Original) The pump control system according to
2 claim 46, including a simulation model for obtaining
3 an estimate of velocity of the downhole pump.

1 48. (Original) The pump control system according to
2 claim 47, wherein the simulation model is based on a
3 multi-section model of the rod string.

1 49. (Original) The pump control system according to
2 claim 47, wherein the simulation model is based on a
3 wave equation model of the rod string.

1 50. (Original) The pump control system according to
2 claim 47, wherein the simulation model is based on a
3 single section model of the rod string.

1 51. (Original) The pump control system according to
2 claim 45, wherein the means for using the operating
3 parameter values to produce command signals includes
4 means for using one or more of the operating parameter
5 values to calculate a value representing rod load and
6 means for comparing the rod load value with preset
7 upper and lower load limit values.

1 52. (Original) The pump control system according to
2 claim 45, wherein determining torque and velocity
3 inputs includes the steps of:
4 measuring electrical voltage applied to a drive
5 motor of the variable drive and electrical current
6 drawn by the drive motor; and
7 using the measured values of electrical voltage
8 and current to calculate values of motor torque and
9 motor velocity for the drive motor.

1 53. (Currently Amended) The pump control system
2 according to claim 45, wherein the means for
3 determining torque and velocity inputs to the rod pump
4 includes sensors for measuring the electrical voltages
5 applied to the motor and currents drawn by the motor
6 and means for using the measured values of electrical
7 voltages applied to the motor and currents drawn by
8 the motor to calculate values of torque and velocity
9 produced by the motor.

Claim 54 (Cancelled).